

AUSTRALIA
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PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:

**"METHOD OF PRODUCING A DIFFRACTIVE STRUCTURE
IN SECURITY DOCUMENTS"**

Applicant:

SECURENCY PTY LTD

The invention is described



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Patent Office
Canberra

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I, LEANNE MYNOTT, ACTING MANAGER PATENT ADMINISTRATION
hereby certify that annexed is a true copy of the Provisional specification in
connection with Application No. PQ 1259 for a patent by SECURENCY PTY
LTD filed on 28 June 1999.



WITNESS my hand this
Thirteenth day of July 2000

LEANNE MYNOTT
ACTING MANAGER PATENT
ADMINISTRATION

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The present invention relates generally to a method of producing a security document or device, and in particular to security documents or devices which include an optically diffractive structure, such as a defraction grating or like device.

The invention is applicable to the production of banknotes, and it will be
5 convenient to hereinafter describe the invention in relation to that exemplary application. It is to be appreciated, however, that the invention is not to be limited to that application.

The practice of applying defraction gratings and like optically diffractive structures to security documents and devices, such as credit cards, bank notes and
10 cheques, has become widely adopted. Currently, defraction gratings and like structures are produced in multi-layer thin films supported on thin carrier structures. The structures are then transferred from the thin film carrier substrate to the security document or device, typically by using a hot-stamping process. Reflective optical defraction devices conventionally contain an ultra-thin vacuum metallised reflective
15 layer, usually aluminium, adjacent to the diffractive structure within the multi-layer structure.

A number of disadvantages are associated with the production and application of optically diffractive devices in this manner. Firstly, the complex and highly specialised process required to produce the multi-layer optically diffractive
20 device structure, which may contain at least four and frequently more layers, is costly. Secondly, an extra process step is required to transfer the optically diffractive device from the carrier substrate onto the security document or device. Thirdly, the resistance of the optically diffractive device as a whole to physical wear and tear and chemical attack is poor due to the weakness of the vacuum metallised
25 reflective layer.

An aim of the present invention is to ameliorate or overcome one or more of the disadvantages of known methods for producing security documents or devices including optically diffractive devices.

The present invention provides a method of producing a security document
30 or device comprising a substrate and an optically diffractive device, the method comprising the step of:

Irradiating an area of the substrate on one surface with patterned laser radiation to oblate selected portions of the surface and thereby form an optically diffractive structure in said one surface.

Accordingly, the present invention significantly simplifies the multi-layered structure of an optically diffractive device when incorporated into the security document or device. The application of the optically diffractive device may be easily integrated into the process of manufacture of the security document or device. Moreover, in those cases in which reflective optically diffractive devices are used, it is possible to eliminate the use of a brittle metallised coating.

The method of producing a security document or device may further comprise the step of placing a mask in the path of the laser radiation to create said patterned laser radiation.

Conveniently, the substrate may be formed from a transparent plastics film. The transparent plastics film may be formed from polymeric material. The substrate may also be formed from paper, paper/polymer composites, coated paper and other non-transparent substrates in those cases where reflective diffraction devices were used.

In one embodiment, the substrate may further comprise a transparent coating applied to the transparent plastics film, the optically diffractive structure being formed in the transparent coating. The transparent coating may be formed from a polymeric material.

In one embodiment, the substrate may further comprise a reflective coating applied to the transparent coating. The reflective coating may be formed from polymeric material and may contain metallic pigment particles.

Conveniently, both the reflective coating and the transparent coating may be formed from material which is similarly resistant to physical degradation, such as by chemical attack.

In another embodiment, the substrate may further comprise a transparent layer applied to the transparent coating. The transparent layer may be formed from polymeric material. Conveniently, both the transparent layer and the transparent

coating may be formed from material which is similarly resistant to physical degradation, for example by chemical means.

In a still further embodiment, this substrate may further comprise a reflective coating applied to the transparent plastics film, said optically diffractive structure
5 being formed in the reflective coating. The reflective coating may be formed from polymeric material and may contain metallic pigment particles.

The substrate may further comprise a transparent coating applied to the reflective coating. The transparent coating may be formed from a polymeric material. The substrate may also be formed from paper, paper/polymer composites,
10 coated paper and other non-transparent substrates in those cases where reflective diffractive structures are used. Both the reflective coating and the transparent coating may be made of material which is similarly resistant to physical degradation, for example, by chemical means.

The method of producing a security document or device may further
15 comprise the step of applying at least one opacifying layer to the substrate, said at least one opacifying layer only partly covering a surface of the substrate to leave at least said optically diffractive device uncovered by said opacifying layer.

The following description refers in more detail to the various features of the method for producing a security document or device according to the present
20 invention. To facilitate an understanding of the invention, reference is made in the description to the accompanying drawings where the invention is illustrated in a number of preferred embodiments. It is to be understood, however, that the invention is not limited to the preferred embodiments as illustrated in the drawings.

In the drawings:

25 Figure 1 is a schematic diagram illustrating steps involved in the method for producing a first embodiment of a security document including a reflective diffractive structure according to the present invention;

Figure 2 is a schematic diagram illustrating steps involved in the production of a second embodiment of a security document including a reflective diffractive
30 structure according to the present invention;

Figure 3 is a schematic diagram illustrating steps involved in the production of a third embodiment of a security document including a reflective diffractive structure according to the present invention;

Figure 4 is a schematic diagram illustrating steps involved in the production of a first embodiment of a security document including a transmission diffractive structure according to the present invention;

Figure 5 is a schematic diagram illustrating steps involved in the production of a second embodiment of a security document including a transmission diffractive structure according to the present invention; and

Figure 6 is a schematic diagram illustrating steps involved in the production of a third embodiment of a security document including a transmission diffractive structure according to the present invention.

Referring now to Figure 1, there is shown a transparent plastics film 2 formed from polymeric material, used in the manufacture of polymer banknotes. The substrate 2 may be made from at least one biaxially oriented polymeric film. The substrate may comprise a single layer of film of polymeric material, or, alternatively, a laminate of two or more layers of transparent biaxially oriented polymeric film. The substrate 2 is seen in cross section in Figure 1. Whilst the invention will be described with reference to Figures 1 to 6 in relation to the production of polymer banknotes, it is to be appreciated that the invention may also be used in the production of credit cards, cheques and other security documents or devices, and that the function and properties of the substrate in those security documents or devices may vary.

In this example, a defraction grating or other optically diffractive device is formed on one surface 3 of the substrate 2 by eradiating an area of that surface with pattern laser radiation. The patterning of the laser radiation incident on the one surface 3 of the substrate 2, may result from the placement of a mask in the path of the laser radiation. The mask 4 may have apertures 5 formed therein such that in those areas where the laser radiation passes through the mask, the light interacts with the surface layer of the substrate 2 in which the defraction grating is to be created, causing material to be ablated or otherwise removed to an appropriate

depth in the surface layer of the substrate 2 and resulting in a three dimensional optically diffractive structure 6.

A reflective coating 7 is then applied to the obliterated surface of the substrate 2. The reflective coating 7 may be a coated polymer layer, containing, for example, metallic pigment particles, or reflective particles, to perform a reflective function. The reflective layer 7 may be applied by conventional printing methods, and may fill the three dimensional structures formed by the laser ablation of the surface 3 of the substrate 2. The coated polymer layer 7 acts as a binding matrix to hold the reflective particles, and provides the strength and flexibility required for the reflective layer to resist physical wear and tear, while the pigment particles may be formed from a material which is resistant to chemical attack.

When incident light 8 from a light source 9 is reflected to a user 10 the reflected light 11 is observed as being diffracted.

Opacifying layers 12 and 13 may be applied to one or more opposing faces of the coated substrate. The opacifying layers 12 and 13 may comprise any one or more of a variety of opacifying inks which can be used in the printing of banknotes or other security documents. For example, the layers of opacifying ink may comprise pigmented coatings comprising a pigment, such as titanium dioxide, dispersed within a binder or carrier of heat activated cross linkable polymeric material. Alternatively, the coated substrate may be sandwiched between opacifying layers of paper.

In order to view the diffractive effect caused by the optically diffractive device, at least a first region of a surface of the substrate 2 may be left uncovered by the opacifying layers.

Figure 2 illustrates a first variation of the method for producing a security document or device according to the invention. In this figure, the substrate 2 is initially coated with a transparent coating 20. The transparent coating 20 may be formed from a polymeric material.

Laser radiation, patterned by a mask 4, is then used to ablate selected portions of transparent coating 20, and to form therein a three dimensional optically diffractive structure 21. A reflective coating, identical to the reflective coating 7

applied to the substrate 2 in Figure 1, is then applied by conventional printing methods to the transparent coating 20. Both the transparent coating 20 and the reflective coating 22 may be formed from coated polymer material or other like material which is similarly resistant to physical degradation, such as by chemical attack. In this way, a counterfeiter wishing to recover the optically diffractive device by desolving or chemically etching the reflective layer 22, would also cause the desolving or chemical etching of the transparent coating 20 and the optically diffractive structure formed therein.

Once again, opacifying coatings may be applied to one or both surfaces of the coated substrate structure 2, 20, 22.

A second variant of the method illustrated in Figure 1 is shown in Figure 3. In this figure, one surface of the substrate 2 is firstly coated with a reflective coating 25, identical to the reflective layer 7 in Figure 1. Laser radiation is then patterned by the mask 4 to ablate material from the reflective coating 25 to thus form a three dimensional optically diffractive structure 26 in the reflective coating 25.

Subsequently, a transparent coating 27 is applied to the reflective coating 25. The transparent coating 27 may fill the three dimensional structure formed in the reflective layer 25. Once again, the reflective coating 25 and the transparent coating 27 may be made from material which is similarly resistant to chemical attack or other physical degradation, in order to prevent the optically diffractive structure 26 from being recovered by a counterfeiter.

Whilst Figures 1 to 3 illustrate examples of a method of producing a security document including a reflective diffractive device, Figures 4 to 6 provide examples of a method of producing a security document including a transmission diffractive device. In Figure 4, one surface of the transparent polymeric film 2 is ablated by laser radiation passing through a mask 4, to form therein the same optically diffractive device 6 illustrated in Figure 1. However, in this example, no reflective layer is subsequently applied to the surface of the substrate 2, so that a defraction effect is observed by the user 10 when light 30 from the light source 9 is transmitted through the substrate 2.

As in previous examples, opacifying coatings 31 to 34 may be applied to opposing surfaces of the substrate 2, leaving uncovered regions or zones 35 and 36 to enable the light 30 transmitted through the optically diffractive structure formed in the substrate 2.

5 In a first variation of this method, as illustrated in Figure 5, an optically diffractive device 6 is once again ablated into a surface of the transparent substrate film 2. Subsequently, a clear coating layer 40 of different refractive index to the substrate film 2, is applied to the surface of the substrate 2. The transparent coating 40, as in previous examples, fills the three dimensional diffractive device 6, and
10 prevents wearing of optically diffractive structure 6. The defraction effect produced by the structure 6 may once again be observed in light transmitted through the substrate and transparent coating.

In method 6, there is illustrated a second variation of the method for producing a security document including a transmission diffractive structure. In
15 this figure, the transparent plastics substrate 2 is firstly coated with a clear coating 45 formed from a transparent polymeric material. A diffractive structure 46 is ablated into the clear coating 45 by means of incident patterned laser radiation. A transparent layer 47 is then coated onto the transparent coating 45 filling the diffractive structure 46 formed therein. The transparent layer 47 and the transparent
20 coating 45 are formed from materials having different refractive indexes, in order that a defraction effect may be observed when light is transmitted through the security device.

It will be appreciated that the methods described in Figures 1 to 6 may be easily integrated into the normal multi-step process during which a substrate is
25 coated or otherwise treated, to produce a security document or device, the laser process merely being integrated into this multi-step process. This method, and the security document or device including an optically diffractive device produced by this method, eliminate the need for a separate manufacturing process to produce an optically diffractive device transfer foil and the separate hot stamp foil transfer
30 process to transfer that diffractive device transfer foil to the product.

The method according to the present invention is capable of producing either reflective or transmissive optically diffractive devices, such as reflective optically variable devices or a transmission hologram.

Finally, it should be appreciated that modifications and/or alterations may be made to the method and security document or device without departing from the ambit of the present invention.

DATED: 28 June 1999

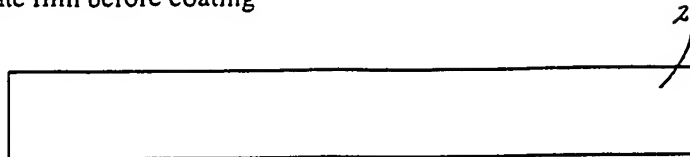
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CARTER SMITH & BEADLE
Patent Attorneys for the Applicant:

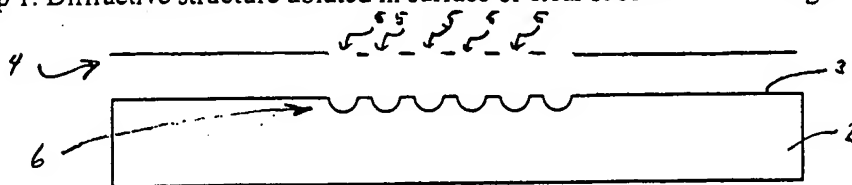
SECURENCY PTY LTD

Figure 1: Method 1 for producing a reflective diffractive structure

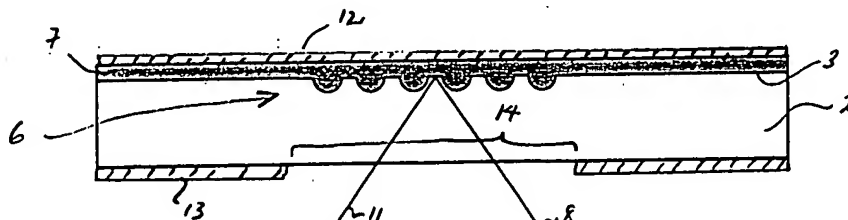
Clear substrate film before coating



Step 1: Diffractive structure ablated in surface of clear substrate film using UV lasers



Step 2: Clear substrate film coated with a reflective layer, filling in the diffractive structure



View diffraction effect in reflected light through clear substrate film

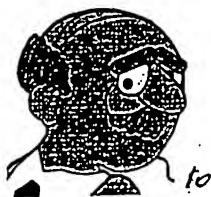
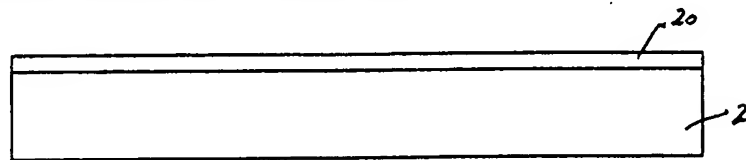


Figure 2: Method 2 for producing a reflective diffractive structure

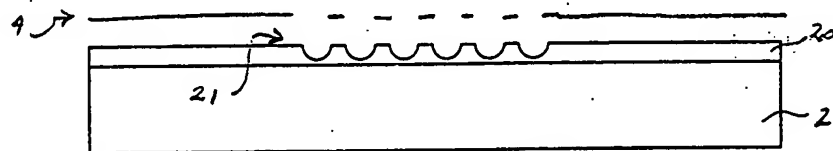
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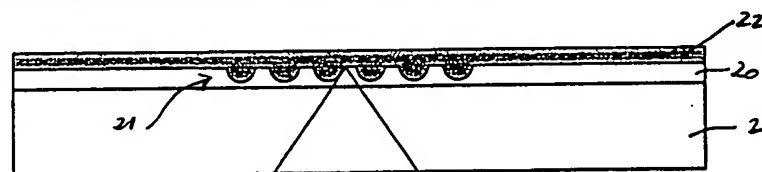
Step 1: Coat clear substrate film with a clear layer



Step 2: Diffractive structure ablated into clear coating layer using UV lasers



Step 3: Clear coating layer coated with a reflective layer, filling in the diffractive structure



View diffraction effect in reflected light through clear substrate film and clear coating layer

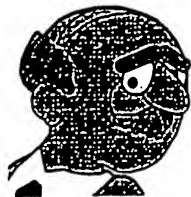
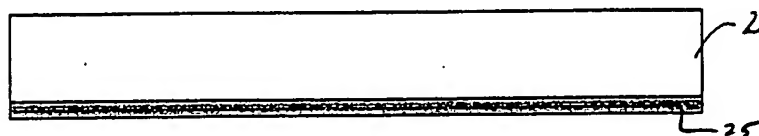


Figure 3: Method 3 for producing a reflective diffractive structure

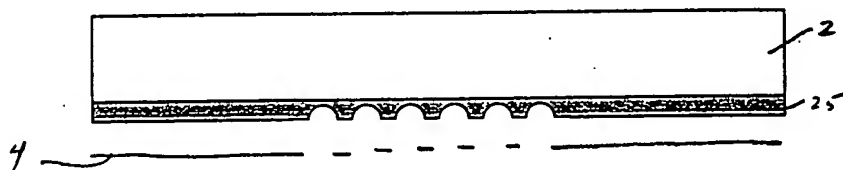
Clear substrate film before coating



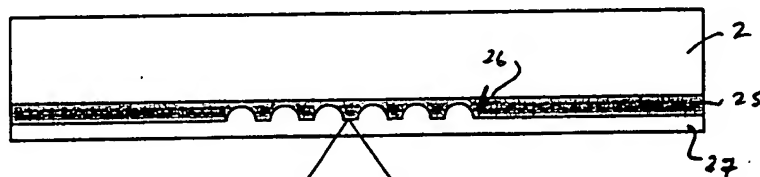
Step 1: Coat clear substrate film with a reflective coating layer



Step 2: Diffractive structure ablated into reflective coating layer using UV lasers



Step 3: Reflective coating layer coated with a clear coating layer, filling in the diffractive structure



View diffraction effect in reflected light through clear coating layer

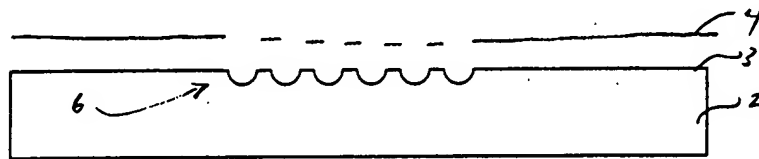


Figure 4: Method 1 for producing a transmission diffractive structure

Clear substrate film before coating



Step 1: Diffractive structure ablated into surface of clear substrate film using UV lasers



View diffraction effect in transmitted light:

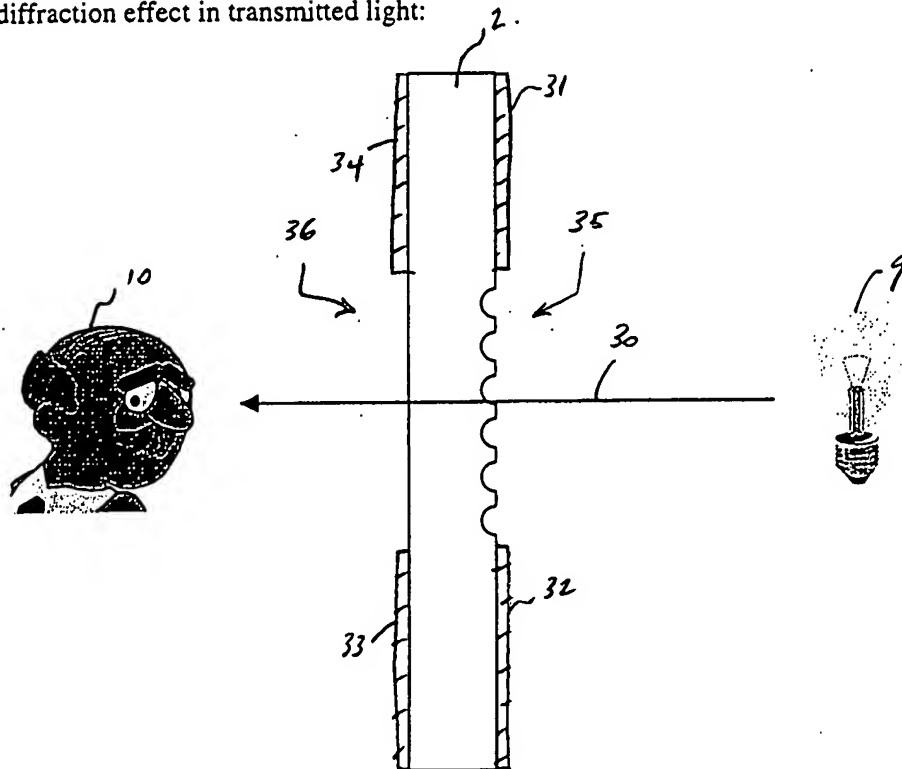
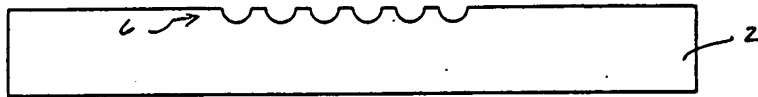


Figure 5: Method 2 for producing a transmission diffractive structure

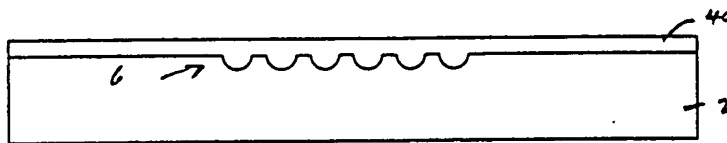
Clear substrate film before coating



Step 1: Diffractive structure ablated into surface of clear substrate film using UV lasers



Step 2: Clear substrate film coated with a clear coating layer, of different refractive index to the clear substrate film, which also fills in the diffractive structure



View diffraction effect in transmitted light:

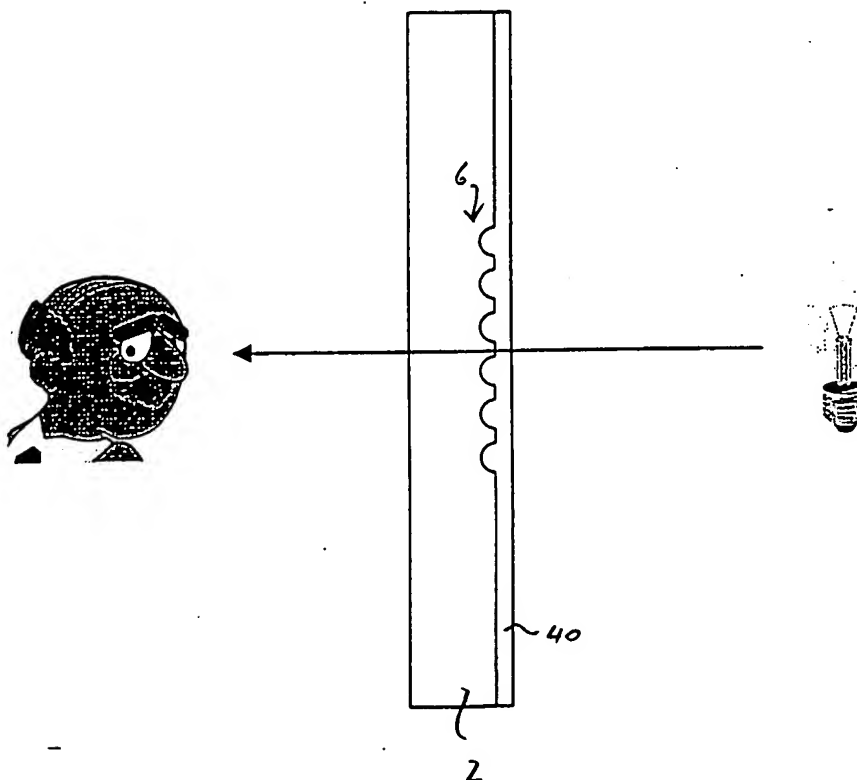
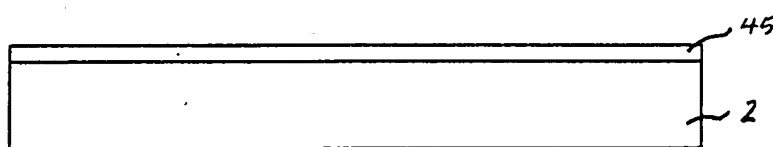


Figure 6: Method 3 for producing a transmission diffractive structure

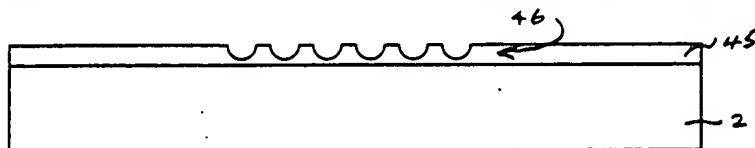
Clear substrate film before coating



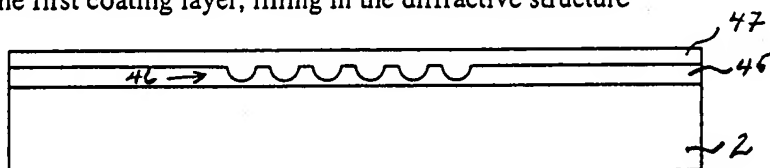
Step 1: Coat clear substrate film with a clear coating layer



Step 2: Diffractive structure ablated into clear coating layer using UV lasers



Step 3: Clear coating layer, of different refractive index to the first clear coating layer, coated onto the first coating layer, filling in the diffractive structure



View diffraction effect in transmitted light:

